## DEPARTMENT OF THE ARMY PERMIT

PERMITTEE: Port of Redwood City

PERMIT NO.: 2015-00058S

ISSUING OFFICE: San Francisco District, U.S. Army Corps of Engineers (USACE)

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate District or Division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below:

#### PROJECT DESCRIPTION:

The permittee is authorized to initially remove approximately 48,000 cubic yards of sediment, and a total of approximately 150,000 cubic yards over the 10-year life of the permit, from 5.2 acres (approximately) within the Port of Redwood City Berths 1-4 located on the western shore of Redwood Creek, Redwood City, San Mateo County, California. The permitted project design depth is -34 feet MLLW plus a 1-foot overdepth allowance. The dredged material will be removed using a mechanical dredge. The dredged material will be transported to an appropriate disposal site by dredged material scows pushed or towed by tug boats. The permittee is hereby authorized to place suitable dredged material at the Alcatraz Island Dredged Material Disposal Site (SF-11), the San Francisco Bay Deep Ocean Disposal Site (SF-DODS), a permitted beneficial reuse site, or at an appropriate upland disposal location outside Corps jurisdiction. All work shall be conducted in accordance with the attached drawings entitled, "Project: Port of Redwood City Berths 1-4 Maintenance Dredging; Location: Port of Redwood City, 675 Seaport Boulevard, Redwood City, California, 94063; Purpose: Maintenance Dredging; Corps File No.: 2015-00058S; Date: February 10, 2015," in four sheets dated February 10, 2015 (Attachment 1).

Prior to each dredging episode, the Dredge Material Management Office (DMMO) will evaluate the sediments to be dredged for disposal or reuse suitability. The DMMO includes representatives from the U.S. Environmental Protection Agency, San Francisco Bay Conservation and Development Commission (BCDC), San Francisco Bay Regional Water Quality Control Board (RWQCB), and the U.S. Army Corps of Engineers (USACE). The DMMO is tasked with approving sampling and analysis plans in conformity with testing manuals, reviewing the test results and reaching consensus regarding a suitable disposition for the material.

PROJECT LOCATION: Port of Redwood City, Redwood City, San Mateo County, California.

## **GENERAL CONDITIONS:**

- 1. The time limit for completing the work authorized ends on **December 31, 2024**. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.
- 2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

- 3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.
- 4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.
- 5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as Special Conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions. (Conditional Water Quality Certification for Maintenance Dredging at the Port of Redwood City Berths 1-4, issued by the Regional Water Quality Control Board, San Francisco Bay Region, under CIWQS Place No. 757775 on August 28, 2015 (Attachment 2).)
- 6. If a conditioned coastal zone consistency concurrence or determination has been issued for your project, you must comply with the conditions specified in the concurrence or determination as Special Conditions to this permit. For your convenience, a copy of the concurrence or determination is attached if it contains such conditions. (Conditioned Coastal Zone Consistency Determination for the Port of Redwood City Berths 1-4 Maintenance Dredging Project issued by the S.F. Bay Conservation and Development Commission (BCDC), Permit No. M93-77, issued April 14, 1994 amended through November 30, 2010, Amendment No. 3 (Attachment 3).)
- 7. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the Terms and Conditions of your permit.
- 8. You understand and agree that, if future operations by the United States require the removal, relocation or other alteration of the structure or work authorized herein, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, you will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration (Section 10 only).

#### **SPECIAL CONDITIONS:**

- 1. All dredging operations shall be limited to June 1 through November 30 each year for the following reasons:
  - a. In order to minimize impacts to federally listed steelhead trout (*Oncorhynchus mykiss*), dredging and disposal operations shall occur from June 1 through November 30. Dredging outside this environmental work window would require consultation with the National Marine Fisheries Service (NMFS) (pursuant to Section 7 of the Endangered Species Act) and approval from the NMFS and the U.S. Army Corps of Engineers.
  - b. In order to minimize impacts to federally listed Chinook salmon (*Oncorhynchus tschwytscha*), dredging and disposal operations shall occur from June 1 through November 30. Dredging outside this environmental work window would require consultation with the National Marine Fisheries Service (NMFS) (pursuant to Section 7 of the Endangered Species Act) and approval from the NMFS and the U.S. Army Corps of Engineers.
  - c. In order to minimize impacts to federally listed North American green sturgeon (*Acipenser medirosrtis*), dredging and disposal operations shall occur only from June 1 through November 30. Dredging outside this environmental work window would require consultation with the National Marine Fisheries Service (NMFS) (pursuant to Section 7 of the Endangered Species Act) and approval from the NMFS and the U.S. Army Corps of Engineers.
  - d. No dredging activities shall occur during the sensitive Pacific herring spawning season, December 1 to March 1. Dredging outside this environmental work window would be determined by the California Department of Fish and Wildlife.
- 2. Additional Standard DMMO Conditions for dredging projects are found on pages 2A-2E of this permit, and shall be adhered to at all times.

# STANDARD DMMO CONDITIONS TO PERMIT NUMBER 2015-00058S

- 1. Your use of the permitted activity must not interfere with the public's right to free navigation on all navigable waters of the United States.
- 2. You must have a copy of this permit available on the vessel used for the authorized transportation and disposal of dredged material.
- 3. You must advise this office as per Special Condition 12, on page 2D, **before** you start dredging activities under the authorization of this permit.
- 4. To provide notification of activities affecting navigation, the permittee shall provide the following information by fax, e-mail or standard mail to the contact listed below **at least two weeks before commencing work**:
  - a. Name and telephone number of the dredge and or project manager.
  - b. Size and placement of any floating construction equipment.
  - c. Radio telephone frequencies and call signs of any marine equipment.
  - d. Anticipated work start and completion dates.

Commander (dpw) 11<sup>th</sup> Coast Guard District Coast Guard Island, Bldg 50-3 Alameda, California 94501-5100

POC:

Local Notice to Mariners Waterways Management Branch

PH: 510-437-2980 FAX: 510-437-5836

E-MAIL: D11LNM@uscg.mil

- 5. The Coast Guard Captain of the Port of San Francisco Bay may require modifications to marine construction equipment deployment or mooring systems to safeguard navigation while work is in progress.
- 6. All vessels operated for disposal of dredged material are required to participate in the Coast Guard's Vessel Traffic Control Service (VTS). Five minutes before each departure, the permittee shall notify the VTS by radio, via Channel 14, of the following: The name of vessel; time of departure from dredge site; and time of departure from disposal site.
- 7. When utilizing the San Pablo Bay Disposal Site (SF-10), the permittee shall dispose of all dredged material within a rectangular area, 1500 feet by 3000 feet, long axis bearing 050 true, and center at latitude 38°00'28"N; longitude 122°24'55"W.

When utilizing the Alcatraz Island Disposal Site (SF-11), the permittee shall dispose of all dredged material within a circular area of radius 1000 with center located at latitude 37°49'17"N; longitude 122°25'23"W.

The District Engineer will determine the specific disposal area and the specific location within the disposal area upon approval of the Dredge Operation Plan (see below).

8. The permittee shall submit the following reports for review and comment to:

U.S. Army Corps of Engineers, San Francisco District Chief, Operations and Readiness Branch Attn: Mr. Mark D'Avignon 1455 Market Street, 16<sup>th</sup> Floor San Francisco, California 94103-1398

- <u>Dredge Material Analysis</u>: Submit, for approval, no earlier than 60 days prior to the proposed commencement of any authorized successive dredging episodes, dredge material analysis (Physical, Chemical, and Biological) sampling and testing information. Please include the U.S. Army Corps of Engineers (Corps) permit number and dredge episode number with this submittal. Also submit Regional Water Quality Control Board (RWQCB) water quality certification or waiver for disposal of the material. For each dredging episode, the permittee shall obtain the approval of the District Engineer for formulating specific sediment testing procedures for the Dredged Material Analysis. The testing protocol will be in accordance with the testing guidelines as published in the Corps and U.S. Environmental Protection Agency publication entitled, "Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual" (The Inland Testing Manual or ITM, EPA-823-B-98-004), dated February 1998, and subsequent amendments thereto. The permittee shall provide a copy of the Dredged Material Analysis to the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Wildlife concurrent with the San Francisco Bay Conservation and Development Commission's RWQCB's, and the Corps' receipt of this information. Agency comments submitted to the Corps within 15 calendar days thereafter will be given full consideration in the decision on dredged material disposal.
- b. <u>Dredge Operation Plan</u>: Submit, for approval by this office, no earlier than 60 calendar days and no later than 20 calendar days before the proposed commencement of dredging, a plan which includes the following: **Corps permit number, dredge episode number,** a copy of the dredging contract or description of the work under which the contractor will do the permitted work; name and telephone numbers of the dredging contractor's representative on site; dredging start and completion dates; names of vessel; dump scow numbers or identification; bin or barge capacities; identification of work as either maintenance dredging or new dredging; discussion of proposed dredging procedures, as governed under Special Condition No. 11, with detailed drawings or specifications of the grid or centrifugal pump system; quantity of material to be removed; dredging design depth and typical cross section including overdepth; and date of last dredging episode and design depth. The Dredge Operational Plan shall also provide the following information:
  - 1. The controls being established to insure that dredging operations occur within the limits defined by the channel dimensions and typical channel section. The horizontal and vertical positioning systems being utilized must be indicated as noted in 3, below.
  - 2. The controls being established to insure that disposal of the dredged material at the disposal site is at the assigned location and depth. The horizontal and vertical positioning systems being utilized must be indicated as noted in 3, below.
  - 3. Method of determining electronic positioning of dredge or dump scow during entire dredging operation at dredge site, disposal site and en route to and from disposal site.

Please note that failure to provide all of the above information may result in delays to your project. When your Dredge Operation Plan has been approved, you will receive a written authorization to commence with your project.

c. <u>Pre-Dredge Survey</u>: Submit no earlier than 60 calendar days and no later than 20 calendar days before commencement of dredging, a survey with accuracy to one-tenth foot that delineates and labels the following: areas to be dredged with overdepth allowances; existing depths; estimated quantities to be dredged to the design depth; and estimated quantities to the overdepth limit. All surveys shall be signed by the permittee to certify their accuracy. Please include the Corps permit number and dredge episode number.

Please note that failure to provide all the above information may result in delays to your project.

d. <u>Solid Debris Management Plan</u>: Submit no earlier than 60 calendar days and no later than 20 calendar days before commencement of work, a plan which describes measures to ensure that solid debris generated during any authorized dredging, demolition or construction operation is retained and properly disposed in areas not under Corps jurisdiction. At a minimum, the plan shall include the following: source and expected type of debris; debris retrieval method; Corps permit number and dredge episode number; disposal method and site; schedule of disposal operations; and debris containment method to be used, if floatable debris is involved.

Please note that failure to provide all the above information may result in delays to your project.

e. <u>Post-Dredge Survey</u>: Submit, within 30 days of the last disposal activity ("last" is defined as that activity after which no further activity occurs for 15 calendar days), a survey with accuracy to one-tenth foot that delineates and labels the areas dredged and the dredged depths. Also, include the Corps permit number, dredge episode number, dates of dredging commencement and completion, actual quantities dredged to the design depth, and actual quantities to the overdepth limit. The permittee shall substantiate the total quantity dredged by including calculations used to determine the volume difference (in cubic yards) between the Pre- and Post-Dredging Surveys and explain any variation in quantities greater than 15% beyond estimated quantities or dredging deeper than is permitted (design plus overdepth allowance). All surveys shall be accomplished by a licensed surveyor and signed by the permittee to certify their accuracy. A copy of the Post-Dredge Survey should be sent to the National Ocean Service for chart updating:

NOAA/National Ocean Service Nautical Data Branch N/CS26, SSMC3, Room 7230 1315 East-West Highway Silver Spring, Maryland 20910-3282.

9. <u>Disposal Site Verification Log (DSVL)</u>: Submit on a weekly basis by noon Monday, the log (downloadable from <a href="http://www.spn.usace.army.mil/Portals/68/docs/Dredging/guidance/document2010-09-07-132110.pdf">http://www.spn.usace.army.mil/Portals/68/docs/Dredging/guidance/document2010-09-07-132110.pdf</a>) that enumerates work accomplished during the preceding week. Mail to:

U.S. Army Corps of Engineers, San Francisco District Attn: Ms. Shelah Sweat, DMMO 1455 Market Street. 16<sup>th</sup> Floor San Francisco, California 94103-1398;

FAXed to Ms. Shelah Sweatt at (415) 503-6693; or e-mail to shelah.sweatt@usace.army.mil. **Please include the Corps permit number and dredge episode number.** The log will be provided when the Corps approves the Dredge Operation Plan and authorizes the commencement of the dredging.

# 10. Overflow requirements:

- a. No overflow or decant water shall be discharged from the barge, with the exception of spillage incidental to mechanical dredge operations.
- b. During transportation from the dredging site to the disposal site, no material shall be permitted to overflow, leak or spill from barge, bins or dump scows.
- c. During dredging operations, overflow shall be limited to a maximum of 15 minutes for hopper dredge only. Adjustments to the dredging operation may be required to insure that once overflow commences, it will not exceed the 15-minute limit.
- d. For approved sand dredging, overflow will not exceed 15 minutes or the economic load, whichever occurs first.
- 11. The permittee shall ensure that all dredged material is slurried prior to disposal to prevent any accumulation or build up of material at the disposal site. All dredged material shall be slurried in <u>one</u> of the following manners:
  - a. Dredged material will be either pumped with a centrifugal pump prior to leaving the dredge site for the disposal site; or,
  - b. If the material is mechanically dredged, passed through a debris grid, with a maximum opening size of 12 inches by 12 inches that will cover the entire loading area of the dump scow. Everything that does not pass through the grid will be considered solid debris and shall be disposed in areas outside of Corps jurisdiction. All such material shall be promptly removed from the grid at the end of each 8 hour shift or sooner.
- 12. The permittee or dredge contractor shall inform this office when: 1) a dredge episode actually commences, 2) when dredging is suspended (suspension is when the dredge contractor leaves the dredge site for more than 48 hours for reasons other than equipment maintenance), 3) when dredging is restarted, and 4) when dredging is complete. Each notification should include the Corps permit number and dredge episode number. The information can be sent to the attention of Mr. Mark D'Avignon, in writing to the address below; FAXed to (415) 503-6693; e-mailed to mark.r.d'avignon@usace.army.mil or via telephone message at (415) 503-6806.

U.S. Army Corps of Engineers, San Francisco District Chief, Operations and Readiness Branch Attn: Mark D'Avignon 1455 Market Street, 16<sup>th</sup> Floor San Francisco, California 94103-1398

- 13. The permittee, as directed by the District Engineer under authority pursuant to the policies and procedures of 33 CFR 325.7, may be required to modify disposal schedules and monthly disposal quantities for particular dredging episodes.
- 14. The permittee shall allow the dredging area and equipment to be inspected by the Corps staff upon request.
- 15. For each dredge episode, the permittee shall be responsible for obtaining a letter of water quality certification from the Regional Water Control Quality Board and authorization from the San Francisco Bay Conservation and Development Commission (BCDC). Water quality certification and BCDC authorization will be a prerequisite to the District Engineer's decision to approve or disapprove specific dredge episodes pursuant to the policies and 33 CFR 325.2(b)(1)(ii) and 325.2(b)(2)(ii).

If a land, ocean, or other aquatic disposal site becomes available for use during the life of the permit, the permittee shall evaluate these disposal alternatives, taking into consideration cost, existing technology, and logistics in light of the overall project purpose to facilitate compliance with the 404(b)(1) Guidelines (40 CFR 230). This evaluation shall be submitted to the Corps at least 60 calendar days before commencement of subsequent dredging episodes. The District Engineer, upon review of this information and after consultation with other resource agencies, may direct the permittee to use such sites in lieu of or in addition to the San Pablo Bay Disposal Site (SF-10) or the Alcatraz Disposal Site (SF-11), under authority of 33 CFR 325.7 and 40 CFR 230.10(a).

#### FURTHER INFORMATION:

- 1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:
- (X) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 403). Section 10 of the Rivers and Harbors Act generally regulates all structures and work occurring below the plane of mean high water in tidal waters of the United States; in former diked baylands currently below mean high water; outside the limits of mean high water but affecting the navigable capacity of tidal waters; or below the plane of ordinary high water in non-tidal waters designated as navigable waters of the United States. Navigable waters of the United States generally include all waters subject to the ebb and flow of the tide; and/or all waters presently used, or have been used in the past, or may be susceptible for future use to transport interstate or foreign commerce. The term "structure" includes, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island or reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, or any other obstacle or obstruction. The term "structure" does **not** include bridges and causeways constructed in or over navigable or tidal waters of the United States, since this regulatory responsibility has been delegated to the U.S. Coast Guard under the Department of Transportation Act of 1966 (Pub. L. No. 89-670). The term "work" includes, without limitation, any dredging or disposal of dredged material, filling, or other modification of a navigable water of the United States.
- (X) Section 404 of the Clean Water Act (33 U.S.C. § 1344). Section 404 of the Clean Water Act generally regulates all discharges of dredged or fill material occurring below the plane of ordinary high water in non-tidal waters of the United States; or below the high tide line in tidal waters of the United States; and within the lateral extent of wetlands adjacent to these waters. Waters of the United States generally include the territorial seas; all traditional navigable waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including waters subject to the ebb and flow of the tide; wetlands adjacent to traditional navigable waters; non-navigable tributaries of traditional navigable waters that are relatively permanent, where the tributaries typically flow year-round or have continuous flow at least seasonally; and wetlands directly abutting such tributaries. Where a case-specific analysis determines the existence of a "significant nexus" effect with a traditional navigable water, waters of the United States may also include non-navigable tributaries that are not relatively permanent; wetlands adjacent to non-navigable tributaries that are not relatively permanent; and wetlands adjacent to but not directly abutting a relatively permanent non-navigable tributary. The term "dredged material" means material that is excavated or dredged from waters of the United States. The term "fill material" means material placed in waters of the United States where the material has the effect of replacing any portion of a water of the United States with dry land or of changing the bottom elevation of any portion of a water of the United States. Examples of such fill material include, but are not limited to, rock, sand, soil, clay, plastics, construction debris, and materials used to create any structure or infrastructure in waters of the United States. The term "fill material" does not include trash or garbage.
- (X) Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. § 1413). Section 103 of the Marine Protection, Research, and Sanctuaries Act generally regulates the transport of dredged material for the purpose of disposal in ocean waters. Ocean waters is defined as those waters of the open seas lying seaward of the base line from which the territorial seas is measured, as defined in the Convention of the Territorial Sea and the Contiguous Zone (15 UST 1606; TIAS 5639).

# 2. Limits of this authorization:

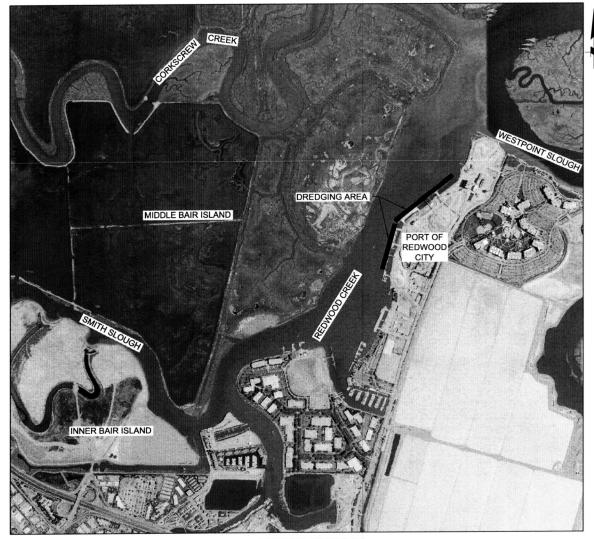
- a. This permit does not obviate the need to obtain other Federal, State, or local authorizations required by law.
- b. This permit does not grant any property rights or exclusive privileges.
- c. This permit does not authorize any injury to the property or rights of others.
- d. This permit does not authorize interference with any existing or proposed Federal project.
- 3. Limits of Federal Liability: In issuing this permit, the Federal Government does not assume any liability for the following:
  - Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.
  - b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.
  - c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.
  - d. Design or construction deficiencies associated with the permitted work.
  - e. Damage claims associated with any future modification, suspension, or revocation of this permit.
- 4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.
- 5. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:
  - a. You fail to comply with the terms and conditions of this permit.
- b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate. (See Item 4 above.)
- c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

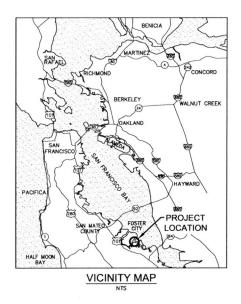
Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 C.F.R. Section 325.7 or enforcement procedures such as those contained in 33 C.F.R. Sections 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the Terms and Conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 C.F.R. Section 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions: General Condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

permit.	
	SEPTEMBER 14 2015
(PERMITTEE)  Don Snaman  Port of Redwood City	(DATE)
This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.	
(DISTRICT ENGINEER) John C. Morrow Lieutenant Colonel, US Army	15 Sept 2075 (DATE)
District Engineer  When the structures or work authorized by this permit are still in exist.	stence at the time the property is transferred, the terms
and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.	
(TRANSFEREE)	(DATE)

Your signature below, as permittee, indicates that you accept and agree to comply with the Terms and Conditions of this





 $\underset{\mathsf{NTS}}{\underline{\mathsf{OVERALL}}}\, \underset{\mathsf{NTS}}{\underline{\mathsf{SITE}}}\, \underline{\mathsf{PLAN}}$ 

IF SHEET IS LESS THAN 22" X 34" IT IS A REDUCED PRINT — SCALE REDUCED ACCORDINGLY.

DATE: FEBRUARY 10, 2015
PURPOSE: MAINTENANCE DREDGING
DATUM: MLLW
CORPS FILE NO.: 2015-00058S

PORT OF REDWOOD CITY 675 SEAPORT BLVD REDWOOD CITY, CA 94063 PORT OF REDWOOD CITY BERTH 1-4 MAINTENANCE DREDGING

FIGURE 1 OF 4 VICINITY & LOCATION MAPS

